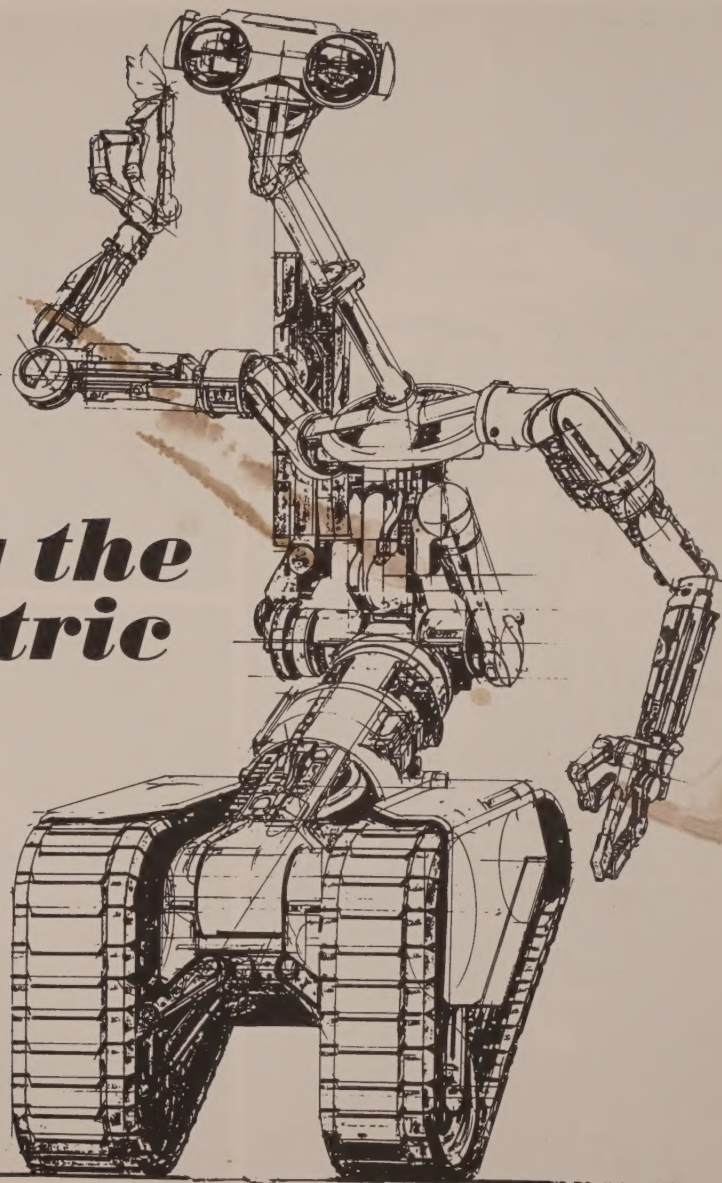


***Building the
Body Electric***



'Star quality,' it has been said, is difficult to define but easy to recognize. It is partly a look, partly a personality that by virtue of its perfection or oddness immediately captures the attention of millions. Eastwood, Streep, Newman and Redford all have it and — judging by the popular success of director John Badham's *Short Circuit* — a six-foot-tall robot named Number 5 has it too. He is witty, endearingly naive, intelligent, cute, potentially dangerous, yet a pacifist — and he single-handedly steals the show.

Well, not quite single-handedly. For in reality, Number 5 is the result of a collaboration of talented writers, an innovative director, a well-respected designer, a team of multifaceted puppeteers and more than forty mechanical effects experts. The 'birth' of Number 5 — which in the film is the miraculous consequence of a lightning bolt — was actually an engineering and design feat almost no less miraculous.

Short Circuit chronicles the adventures of a highly sophisticated, technologically-advanced, \$11 million robot that is part of a series designed to be lethal combat weapons. Though his inventor, Dr. Newton Crosby (Steve Guttenberg), contends that the robots don't think or feel and are mere machines that 'just run programs,' an act of nature inexplicably turns robot number five into a thinking, feeling and independent creature. Number 5 is alive — and *Short Circuit* is off and running. Inadvertently escaping the confines of the Nova Robotics plant that manufactured him, Number 5 finds himself out in a world he does not understand — nothing in his computer banks has prepared him for cows or gas stations or pretty young girls. He meets Stephanie Speck (Ally Sheedy) — one such pretty young girl with a propensity for taking in strays — and delightedly soaks up 'input' in the form of books and television. Meanwhile, military personnel are frantically searching for their multimillion dollar weapon. Once convinced that Number 5 is indeed alive, Stephanie tries to protect him from the military brass and scientists who believe him to be only a malfunctioning, dangerous piece of machinery.

Written by S.S. Wilson and Brent Maddock, the script for *Short Circuit* was an immediate 'hot' property. "David Foster and Larry Turman have been sending me scripts for years," John Badham admitted, "and I kept sending them back, saying no. But they sent me *Short Circuit* and said, 'We're not going to mess with you this time — we're sending this script out to four other directors so you'd better read it quick.' I started reading it right away and I thought it was really good. I was very excited about it because the character of the robot was so much fun and so special. So, *this* time, I called Foster and Turman right

back. We set up a lunch meeting and it was done."

The character of the robot that so charmed John Badham had been many drafts in the making. Indirectly, in fact, it had been many *years* in the making. Cowriter Steve Wilson had been fascinated with robots since his childhood. Intensely interested in animation, but stymied by his own inability to draw, Wilson began exploring other options. "I turned to stop-motion animation," Wilson recalled, "but I couldn't really sculpt very well either. My dinosaurs didn't look anything like anybody else's dinosaurs. So I started animating *anything* that had moving parts on it and, over the years, I developed a knack for putting life and character into things that were totally nonanthropomorphic. A robot, of course, would be a perfect device for my particular talents and I pitched robots to the educational film market for years. I was finally allowed to do 'Library Report' which featured a talking robot explaining how to use the library. I built the robot out of junk parts from surplus stores and it was all done with stop-motion. The film was a tremendous hit in the educational market and, in my mind anyway, that robot was the forerunner of Number 5."

Deciding it was time to tackle another screenplay — and writing only on 'spec' — Wilson teamed with Brent Maddock and the two began creating a story with a robot as its central character. "I envisioned it as a low-budget movie," Wilson commented, "with me doing the stop-motion animation for the robot. The germ of the idea was that the robot was alive — I knew that from day one — but I didn't know how that was to come about. My first thought was that it could be a person who had been mechanized until only his brain remained intact, but Brent threw a fit about that because it was so grisly. So we started with the problem of how a robot could be alive and then actually die if it got disassembled. We thought of aliens coming down and zapping the robot alive. We thought of aliens coming down and *they* are machines and *they* are alive. Finally, we went back to the old lightning bolt gag, even though we didn't want to. We never could come up with anything else that was as clean. We didn't want the story to get bogged down with *how* Number 5 comes alive. The point is, he comes to life; and we hoped the audience would buy that so we could get on with the story."

Though hardly the novice writers they have been described — both Maddock and Wilson had been making their living as writers for ten years and the *Short Circuit* script was *not* an assignment for a UCLA class as has been reported — they were understandably excited that the script was met with such enthusiasm. The low-budget, stop-motion animated film they had envisioned was now in the hands of a major studio and a high-powered director. With Badham at the helm, the notion of using stop-motion animation to achieve the robot effects was one of the first things to go. "There was a strong prejudice against using stop-motion for this project, from the very beginning," said Wilson. "Even before Badham came on, David Foster was against the idea. He had been one of the coproducers on *Cave-*

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article by
Jody Duncan Shay

Director John Badham rehearses his performers — both live and mechanical — during principal photography on Short Circuit. Derived from a screenplay by S.S. Wilson and Brent Maddock, the film opens with the unveiling of a new line of sophisticated, laser-equipped military robots, one of which is struck by lightning and unaccountably comes to life with an abundance of curiosity and a blossoming sense of self-preservation. / At his All Effects facility in North Hollywood, Eric Allard — who assembled a fifty-man crew to engineer and build the robot action props — discusses construction techniques with visual consultant Philip Harrison and co-producer Dennis Jones. / Although five robots would be featured — with Number 5 being most prominent — twenty-seven full and partial robots were required to fulfill the demands of the script.

man and he felt they'd really gotten burned on the stop-motion effects. I was running around with my demo tapes of the original educational film from which Number 5 grew, showing everybody what the potential was. And we'd written a number of scenes specifically to exploit the capabilities of stop-motion — like one where Number 5 did some fancy shuffling and dealing with a deck of cards. But, understandably, Badham didn't want to turn over the central character of his film to postproduction. He didn't want to be on the set thinking, 'Gee, I hope they do a good job with my main character in this scene.'"

Having rejected the concept of using stop-motion animation to create his 'star,' John Badham began talking to various effects facilities — among them, Apogee, ILM and the Carlo Rambaldi organization. Even actual computerized robot manufacturers were approached, though that option was quickly discarded. "We realized that we were going to have to use every movie trick in the book to actualize this robot," explained Badham. "There was no way we were going to be successful if we tried using real state-of-the-art robotics — you can really get tangled up in that sort of technology. Sometimes relying on old rubber band and paper clip techniques is the best thing to do."

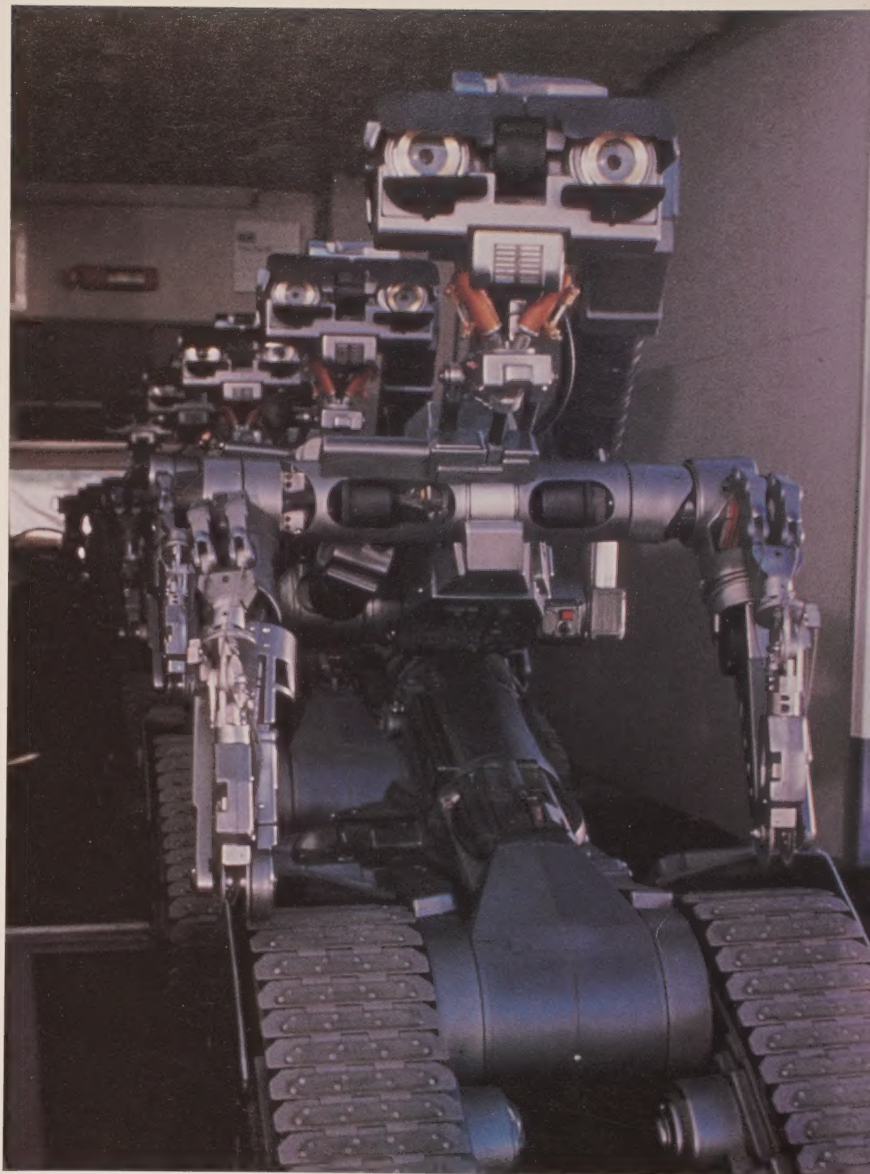
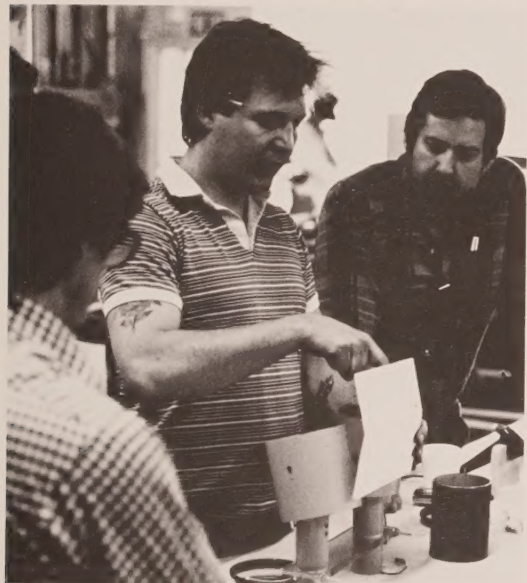
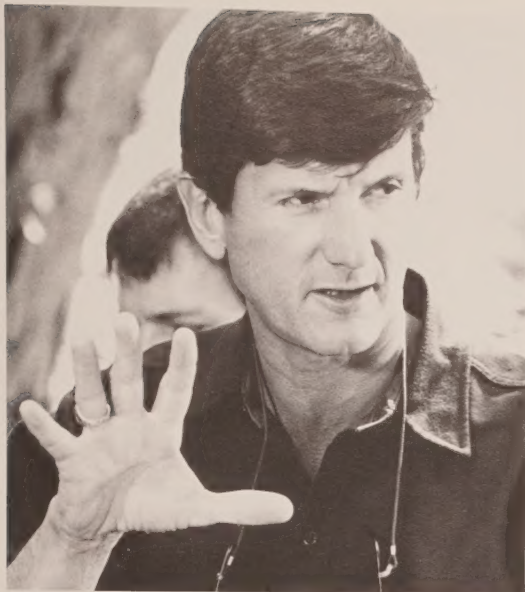
Badham was fortunate in finding Eric Allard, a young mechanical effects wizard who had already tackled the difficulties in building a robot for a Showscan film called *Let's Go*. "The 'Pal' robot featured in *Let's Go* had actually been designed by Dan Goozee," Allard related, "and was operated by a rod-puppetry technique that Doug Trumbull had come up with. Like Number 5, it had a lot of character and expression in its face. After John Badham and his group saw *Let's Go* — which was part of a robotics exhibit at the Tsukuba Expo in Japan — they gave me a call. I got the script on a Thursday or Friday and over the weekend I came up with a proposal. I broke down each scene and each page and noted what kind of robot prop I thought they'd need. I told them the last thing they wanted was a real robot, which I think is what sold them on my concept. A real robot has no place on a sound stage. I had worked on *Brainstorm* which had some industrial robots and they proved to be real time-consuming to shoot — reprogramming them for just a slight artistic change was a real hassle. My concept would give the director spontaneous input — just like working with an actor."

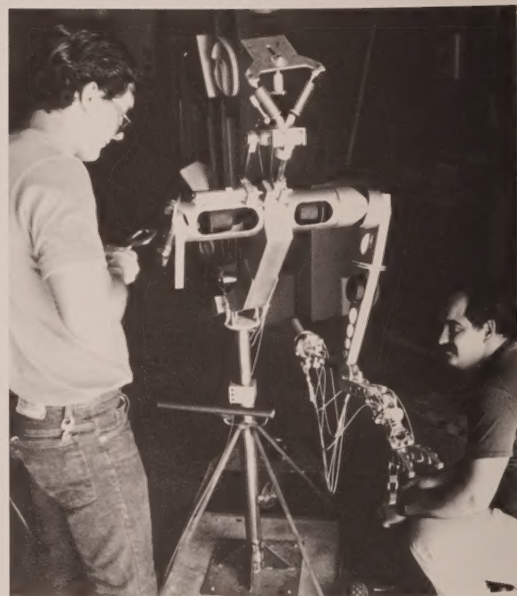
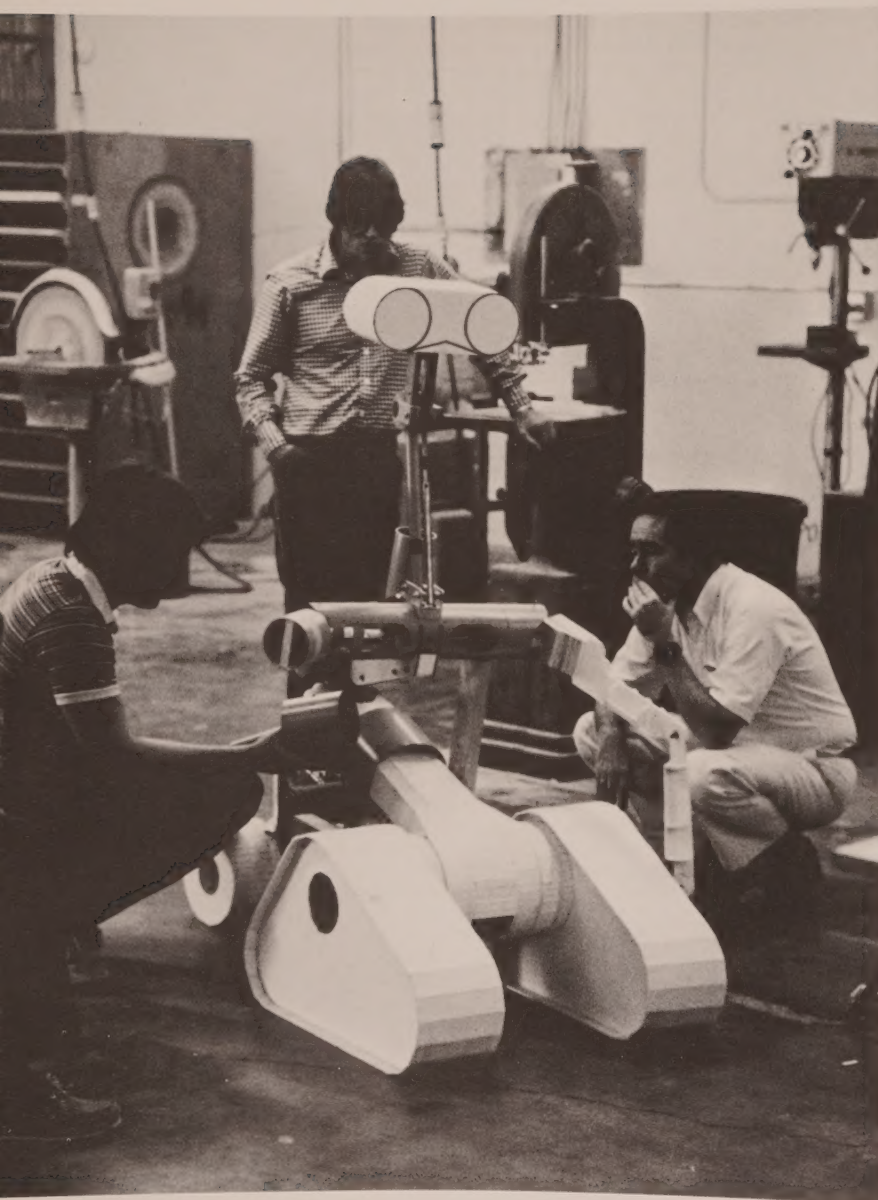
Principal photography was scheduled to begin in just over five months, leaving Allard with a ridiculously short amount of time in which to build a character that had yet to be designed. The schedule was tightened further by the fact that Badham was hoping for a month of testing and rehearsal with the robot before shooting commenced. Aware of the complexity of the undertaking, Badham needed a designer with more than just a fanciful grasp of hardware and technology. "I wanted this robot to take us a hundred years into the future," Badham said, "and that was a very tall order. In the first place, Number 5 was a foot soldier. What kind of thing is going to do that job? It had to have some kind of firepower, some ability to move around

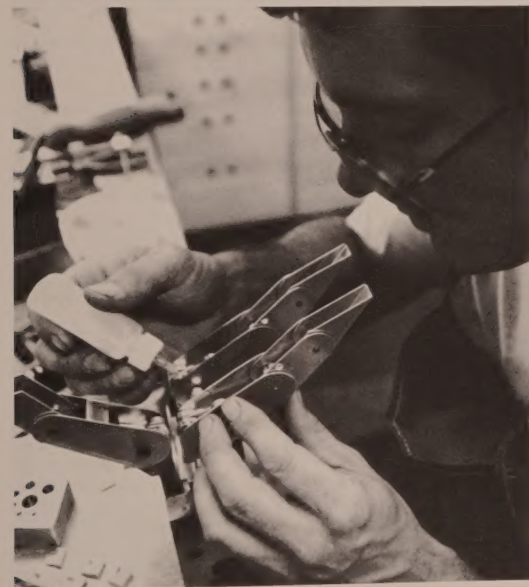
on all sorts of terrains. It had to be capable of handling situations you would send a human being into, yet invulnerable enough to survive warfare. You also had to be able to get some expression and emotion and *feeling* out of this guy because it was essential that the audience empathize with him. He couldn't be the faceless, anonymous character in *2001*. And he couldn't be what we had in *Wargames* — a slightly devilish computer that was really just blinking lights on a box. He had to be a *person* of sorts, yet designed so that it was apparent that he wasn't *really* just a person in a suit."

To fill his 'tall order,' Badham approached Syd Mead. Mead was not only an experienced designer in the film industry — having done work for *Star Trek*, *Blade Runner* and *2010* — he was also a prominent industrial designer. "What made this project so fascinating," said Mead, "was coming up with a robot that was a dramatic character. In effect, we had to create a robot that could satisfy all the same story and dramatic requirements as a live actor yet within considerable mechanical limitations and time constraints." Before beginning his design work, Mead was sent to the Tsukuba exhibition where a number of state-of-the-art, ambulatory robots were on display. "The thing that impressed me from what I saw in Japan was how slowly real robots move. Number 5 had to move in choreographed sync with real actors, which meant a fairly quick reaction time that real robots just don't have. We are a long way from Number 5 in real-life robotics. I was, however, influenced by what I saw there and some of the linkages and joints and rotational details of the real robots found their way into Number 5's design. The biggest influence was an organ-playing robot which was fixed to a piano bench and actually scanned sheet music with its optical system. I was interested in that one because it had two camera eyes with bifocal vision and it had some expression on its face — which was, of course, a primary concern in designing Number 5."

Once back from Japan, Mead began daily meetings with John Badham, visual consultant Philip Harrison and Eric Allard, who had been included for his own design input and to ensure that the interesting ideas being put down on paper could realistically be built. The meetings would continue for an intensive six weeks of design give-and-take. "Some of those meetings seemed to go on forever," Mead admitted. "The four of us would have a sort of 'drawing' discussion, everyone scratching things out on paper; then I would take home my notes from that discussion and do specific, detailed drawings. From those drawings we'd decide if we wanted to include a certain characteristic or what changes needed to be made. It was a very collaborative process." One of the first priorities was deciding how Number 5 would move. "Since the robot had to move very fast and be quite agile, I thought wheels might be the way to go about it. I proposed a three-wheel system, like a tricycle. The wheels would be mounted on articulated suspension legs that would allow you to bring the wheels together so the robot could stand up. It was very spindly looking and I liked it very much, but it







wasn't suitable for Eric's mechanical requirements. In order for the machines to actually move around on their own power, they would have to have pretty hefty batteries on board and there was no place in this design to put those batteries. All of the other bodily parts were going to be very thin and spindly so that the audience would *know* that it was a real machine with nobody hiding inside of it. We had to have *someplace* where Eric could put all the mechanical stuff, so we went with tracks which gave us a good heavy base. It worked dramatically too because tracks enforced the idea that this was a military machine."

Number 5 also required some flexibility in height with the ability to squat down into a 'combat' position and raise up to an eye-to-eye level with his human costars. "To get that scissor action required articulation of the main stub of his body at the bottom," Mead continued. "It could move back towards the rear, making it shorter; then, as it moved forward it would raise up by about a foot. The neck also periscoped up and down. Another thing I did with his body was to give him a dropped shoulder look so that it wasn't exactly symmetrical. His laser was off-center on one side and that added an odd asymmetric accent that made it look almost endearingly clumsy or awkward. It was very important that it *not* just look like an armature for a piece of sculpture that was later going to be covered up with something. It had to look like a highly specialized machine which, because of its function, just *happened* to look like a human being." One of Number 5's nonhuman characteristics was his third arm, called the tool arm. The tool arm had been the writers' invention and, in the script, had been capable of many functions similar to the James Bond gadgetry. Practical considerations made a simplification of the arm a necessity, however, and in the final design it is neatly folded into his backside, rarely seen or used.

As the key to his personality, a great deal of the allotted design time was spent on Number 5's face and head. "Originally, I proposed that the face and head not be totally anthropomorphic," noted Mead. "I wanted it to be more machinelike and have a happenstance resemblance. It's strange how quickly we perceive a face out of three dots. You get 'face' very rapidly when you are playing around with mechanical detail and I wanted to stay away from that. So I kept coming up with these sketches that were very machinelike and logical for what a thing like this would have to do. But as we progressed, John decided he wanted two matching eyes and a mouth — more of a symmetrical face." Most of the robot's 'acting' ability would come from his expressive and flexible eyes and eyeflaps. "His eye flaps acted as eyebrows and they were originally the flash shields that you would have on a sophisticated scanning device to protect it against sudden bursts of light — anything from nuclear explosion to blinding flashlights or flares. They become his eyebrows in the course of the film because they get damaged and they flop a little bit and your mind makes that immediate connection. For the actual eyes, I had preferred a very complicated optical system that would occur *behind* the lens but they

Several weeks of the short preproduction schedule were devoted to conceptualizing the all-important robot. Principal designer was Syd Mead — working in close collaboration with Eric Allard, Philip Harrison and John Badham. Allard demonstrates for Harrison and Mead a foam-core study mockup fashioned prior to the actual construction phase. / Design interpreter Chris Ross prepares a vacuform pattern needed to produce panel coverings for the radio-control versions of the robot. / Richard Hill and Robert Horvatic install a completed arm mechanism on one of the rod- and cable-controlled puppets developed primarily for closeups. / Although the basic chassis was aluminum, other lightweight materials were used whenever possible. Adam Gelbart files out eye sockets in an epoxy resin headpiece. / During assembly, Rick Hill lubricates one of the articulated hands designed by Allard.

eventually used a mechanism that Eric came up with. It was there and available and it was more out in the open—you could actually see the mechanism sliding back and forth and up and down.”

The fact that the robots were supposedly built for military purposes was another important consideration in the design process. “The laser was mounted on the back to resemble the way soldiers carry guns on their backs when they aren’t using them,” Mead explained. “They are back out of the way but can be instantly brought into position when needed. And it comes into position right by the head so it’s in line with the robot’s scanning system—a very logical position for the weapon to be in. Another design element that we hoped would make the robot believable as a military weapon was its ability to crouch down into a lower silhouette as if in combat. Also, the treads denoted military use and were covered with shrouds. Philip Harrison did a delightful series of ‘attitude poses’ in camouflage colors just to get us into the spirit of the whole military thing. There was some talk at one point of painting them—for the purpose of the opening military demonstration—in arctic white and jungle camouflage colors to demonstrate that they were suited to all environments, but that idea was eventually dropped.”

Though Eric Allard had been in on the process from the beginning, the prospect of actually bringing Number 5’s approved design into three-dimensional reality was an overwhelming one. “Syd comes up with wonderful stuff,” Allard asserted, “but because he is about fifty years ahead of the rest of us, there are problems automatically built in. With every new step in the design, more problems were introduced. I had been included in the design phase, partly to keep everything under control mechanically, but I figured this movie was my big shot and I just wanted to go for it. I didn’t ever want to say, ‘No, we can’t do that.’ By the time the design was finalized, I looked at it and thought, ‘Oh my God!’ The design had progressed from something that would have been fairly easy to build to something that was just about impossible. But I had made a lot of claims and promises and I just had to do it.”

Allard had three-and-a-half months in which to complete the various action props that collectively would become Number 5. “There were certain things in Syd Mead’s drawings that I realized right away wouldn’t really work,” Allard commented. “The width of the tracks, for instance, scaled up to real size, wouldn’t fit through doors. Also, the final drawing didn’t have a place for him to rotate at the waist. I was pushing for a very low base rotation—which would have been simpler to build—but in the interest of anthropomorphizing him, they wanted the rotation to be at the waist. That was very difficult because it meant that his whole upper torso had to meet at one little rotation point at the waist and still function. I also knew the neck would be a problem. It was supposed to be able to go back and forth while the head remained parallel to the floor. But the neck joint, as shown on the drawing, couldn’t possibly support

the weight of the head. The design also gave us no place to put motors to work the robot’s arms. A real robot with functioning arms would have a big power pack at the elbow—or a power unit under a table somewhere, which would limit its mobility. Arm movement was obviously very important if the robot was going to gesture convincingly. Finally, the design called for Number 5 to be able to adjust his height all the way from a squatting position of only four feet to a maximum height of seven feet. Geometrically that just wasn’t practical. We had to settle for forty-seven inches as its maximum low and six-and-a-half feet as its maximum height. Those were just some of the initial problems—the *all-consuming* problem, of course, was that this thing had to do such an amazing variety of things.”

Allard had tackled the amazing range of Number 5’s capabilities in the original proposal he had submitted to John Badham. Breaking down each of the robot’s many scenes, he had calculated that no less than twenty-seven action props would be required to perform all of the robot’s astounding functions. “What I called the ‘Type 1’ robot was the main radio-controlled, full-size unit that would be used for long shots,” Allard explained. “There were eight of those and they were as fully-articulated as possible, but without a great deal of detail. As many as nine operators were required to articulate the Type 1 robots, which had forward and reverse movement with variable speed, base and neck rotation, arm and elbow articulation and the laser functions. This unit would establish that Number 5 could move under his own power and at least *suggest* that he could do everything else.”

The bulk of Number 5’s more complicated actions would be performed by waist-up rod puppets mounted either on dollies which could be pushed or a teeter-totter rig which could raise and lower them. “The puppets basically had all the same functions as the remote control robot, except that they were rod-actuated and they were only from the waist up. The only motorized articulation they had was the bend at the waist, the upper boom movement back and forth, and the sort of turkey neck movement of the head. Everything else was puppeteered, either by cable or hydraulic systems.” Since Number 5 would be required to fix a martini, make breakfast and generally gesture in a realistic way, the puppet’s arms and hands were of utmost importance. “The arms were designed so that the operator actually put his hands into them—attached at the elbows—and then manipulated pull rings that caused the puppet’s hands to respond according to specific movements made by the puppeteers.” Insert arms were also built to perform the more complicated manipulations. “We built two sets of insert arms—two rights and two lefts. They were used in the beginning of the film where there are closeup shots of the robots mixing drinks and again in the same sequence where they assemble a model airplane—a bit that was later cut. They were also used when Number 5 pulls the tablecloth off the table and for shots of his arm coming out of the truck and adjusting the rear-view mirror. Anytime it was just a hand and an arm

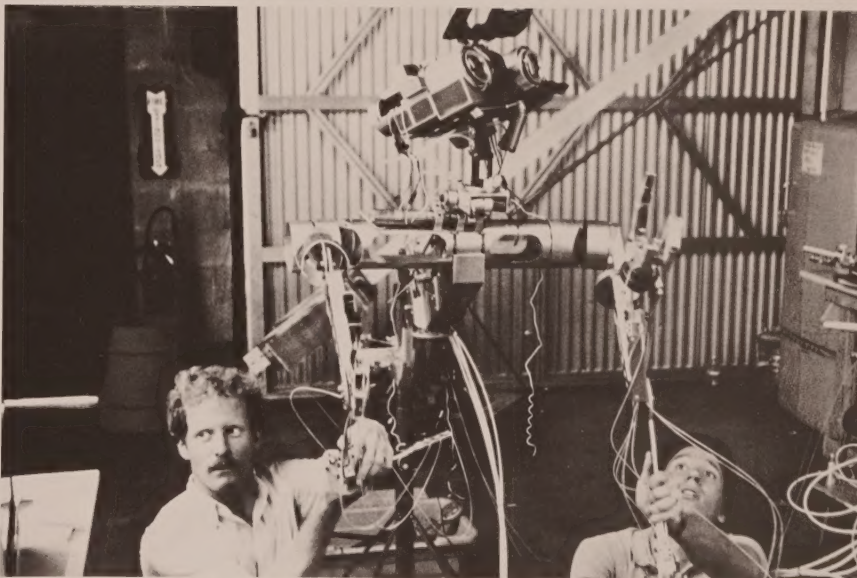
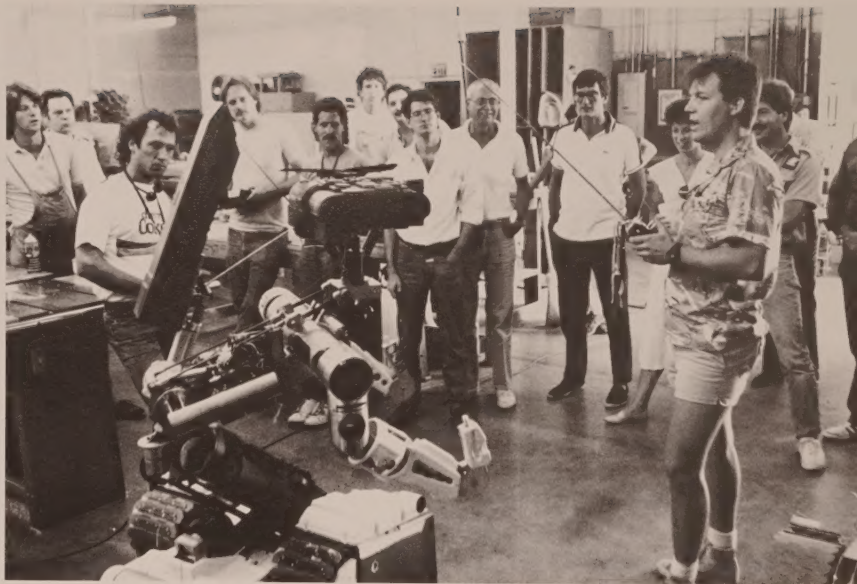
Eric Allard puts a prototype robot through its paces during a preliminary workout for John Badham and the producers. In addition to moving forward and backward, the finished artifact could rotate at its base and neck, articulate both arms, shift from a crouched to upright position and bring its laser weapon to bear. In all, eight of the full-size, radio-control robots were fabricated—each requiring nine external operators to produce its full range of functions. / Tim Blaney and Carl Johnson—members of Tony Urbano’s puppeteering team—practice with one of the rod-and cable-actuated variants. Two sets of insert arms were constructed and employed whenever especially intricate hand and finger manipulations were required.

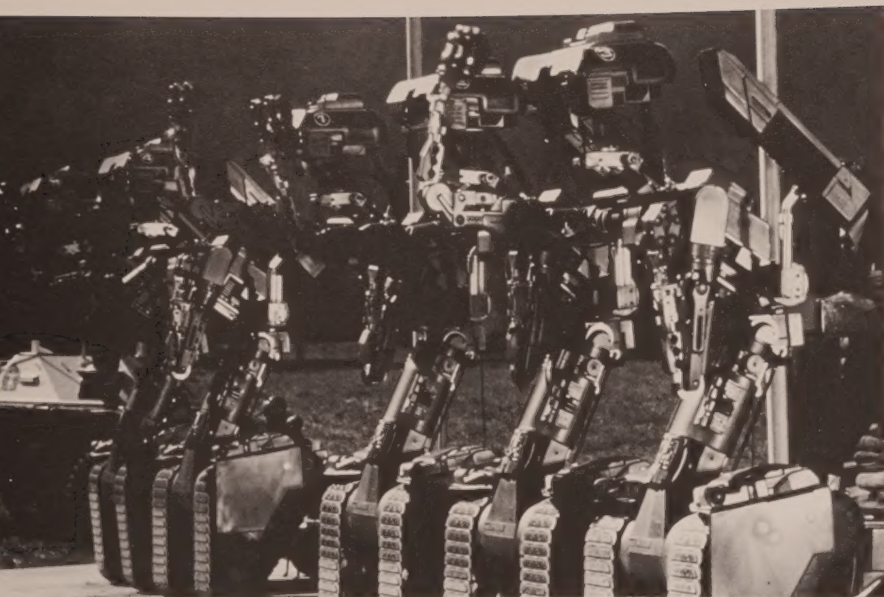
doing detailed work, we used the insert arms. In other scenes, we'd set up the robot with no arms behind a table, for example, and then have a guy operating an insert arm on either side of him. As long as the shot was framed in a certain way, it looked perfectly natural."

To allow for optimum flexibility during shooting, each of Number 5's parts was made to fit *any* version of the robot — radio controlled, puppet or dummy. "Everything was made so you could take any part of any robot and put it on any other robot. I knew it would be essential when we actually got out there and started shooting. It doesn't matter how well you plan these things; when you get on the set with a creative director like John Badham, things are going to come up and you have to be flexible enough to accommodate him." Because of this flexibility, only five heads were actually needed, each able to attach to any type of robot. "Three of the heads were capable of sixteen separate functions, and we ended up with more than twenty servos just in the heads alone. The eyes could pan and tilt and there was an iris which worked inside the lens. They had eyebrows that were pretty complex, too. They could flap, either together or independently, and the whole assembly tilted back. The eyes also had louvers on the sides that opened and closed." The head also included a voice module — a panel of lights the audience could relate to as the source of Number 5's voice. "We used a wireless remote microphone that Tim Blaney — who was the head operator and the voice of Number 5 — would speak into. As he did, the lights on the voice module would start to dance. It was like a color organ — the louder he talked, the more lights would come on." The remaining two heads were simpler versions, each with their own special function to perform. "One head was intended just for the scene where Stephanie first sees Number 5 in her truck and she thinks it's an alien. That one had huge projector bulbs in its eyes and, though it did have some upper eye flap functions, it didn't have the atmospheric sensors or most of the other eye movements. The fifth head was the 'bug-eye' head. Its eyes were rigged so they could actually pop out. It was a subtle effect and we ended up using it only a couple of times — for the scene where Number 5 sees Stephanie naked and also when he chases the grasshopper."

Like all stars, Number 5 required stunt doubles to take over when the action got too rough. "We built eight stunt robots that had little or no articulation. A couple of them had some lower boom-type action so we could position them specifically for a shot, but there were no radio controlled functions on any of them. They were going to take a lot of abuse, so there was no point in putting delicate mechanisms in them." Even the heads were dummies. These were to be used for shots of him falling off the truck and falling into the chicken coop, among others. Allard and his crew also built eight half-scale miniatures with little parachutes on them for a scene in which Number 5 is catapulted off a bridge.

"At the very beginning of the project," Allard recalled, "Tom Pakh, Rick Hill and I built a full-scale, foam-core mockup of the





robot. Tom and Chris Ross then built the patterns. Since they had worked with Syd Mead on two other films, they were very good at interpreting his drawings. The mockup was basically to show the size of the robot in relation to everything else — to make sure it could get in and out of vehicles and that type of thing. It was also to work out some of the basic geometry for the large body functions — the boom going up and down, where the actuator should be placed, the parallelograms for keeping the upper torso parallel to the floor. As soon as the mockup was finished, Tom Pahk began making parts. Dave Schwartz set up the mold shop — we realized by that time that we were going to need over fifty different molds for this thing. Ron Gress did the painting, which was a major task in itself. Chris Ross worked on concepts for the head — which at that point still wasn't very clearly defined — so he spent the first six weeks just on the face. I'd had an idea for a multiple compounding eye which Stuart Ziff worked out, but it was too big and wouldn't fit in the face. So we still had design details to work out as we went along."

Having solved some of the basic geometry problems with the mockup, Allard and his crew turned to building a prototype robot from which all the Number 5s would derive. Since the mechanics of the robot were of the utmost importance, form — out of necessity — followed function. "I brought in Joss Geiduschek — an engineer I'd worked with at Doug Trumbull's place — and Mike Sorenson and the three of us began working on the mechanical drive system for the main body chassis. Mike had a lot of experience working with experimental aircraft, which is why I wanted him working on the chassis. If you look out the window of a 747 during turbulence, you'll see the engine swinging around out there — it's almost scary. But they are built that way so that they'll be flexible enough to take shock and not fall apart. I felt that flexibility was important for the robot also. It was going to be riding over some rough terrain in the course of shooting and, like an aircraft, it had to be as lightweight as possible. It couldn't be so rigid that it wouldn't be able to take some abuse and handle a variety of situations. We had talked in early meetings about putting little trails down everywhere the robot went. But I knew that once we got into the reality of location shooting, that wouldn't be practical. It had to be flexible enough and durable enough to go anywhere John wanted it to go."

While working out the drive system of the main body chassis, Allard delegated the electronics work to Richard Chronister and Mark Noel. "There were some initial electronics problems with the prototype," Allard recalled. "We had some high-tech components, but for the most part I tried to keep it low-tech so that it would be simple enough for any special effects guy to go in and fix. So we were ironing out electronics problems while everything else was going on — still aiming to complete one prototype on which *all* the problems had been solved. Phil Bartko and Ely Schless were working out the articulations of the head and face. Once we had the mechanics figured out and

we knew how everything would attach, Tom Pahk and Chris Ross would go in and design a cover for it. It was always a matter of form following function — we'd make a mechanical form that worked, then Tom and Chris would cover it, matching Syd Mead's drawing as much as possible."

When a trial run of the prototype proved successful, Allard gave the go-ahead for mass production to begin. "We made fifteen of everything — fifteen sets of arms, fifteen of all the body parts. The chassis was all aluminum but we used a lot of different materials for various coverings and shells — such as fiberglass, styrene, liquid wood, polyester and epoxy resins. We made lightweight molds from everything because we had a lot of surface detail and that was the only way we could get multiple parts and the only way we could even get them out of the mold. So the bulk of the thing was fiberglass pieces formed out of molds and the rest was high-impact styrene that we vacuum-formed. We didn't want to have to use grease anywhere on the robot — we knew there would be sand and dirt out on location and if we used grease in the joints it would pick that stuff up. So we used all lubricated polymers for the joints — teflon impregnated delron and things of that nature. One of the things that really saved us, time-wise, was our ability to find things off the shelf that we could use. The hardest thing about this kind of project is getting the parts and materials you need in time. One of the actuators we needed was custom made in Switzerland and they said: 'No problem! We can deliver that to you in four months.' You're always fighting that kind of thing. We had people flying back and forth from Japan on special planes just to get some of the servos we needed fast enough."

Eight weeks into the project, mass production was completed. Aluminum and fiberglass pieces, mechanical joints and electronic components were stacked everywhere at Allard's facility, waiting to be assembled. "Just the assembly was a huge job," said Allard. "We had two guys working on the tracks alone for a couple of months. We had used this track that was a conveyor belt for automated production lines in food factories; but since it wasn't designed to be used as tread, the sprockets that drove it caused it to bounce. So we had to modify each sprocket, cut the corner off of each little segment of tread and pop rivet a piece of rubber on to it to give it a tread look. There were thousands and thousands of pieces of track that had to be modified. It was pretty intense because we were up against a shooting deadline. About six weeks prior to the first day of production we gave John and the producers a demonstration of a completed Type 1 robot and they were all smiles. It was the first time they realized that they were going to have something really special."

One by one, the multiple Number 5s came off the production line. Though their assembly was tedious, the process went smoothly — with one notable exception in which life seemed to imitate art. "We had robots one through fifteen and, believe it or not, the first one that short-circuited was number five. It was almost spooky. It went up in a puff of smoke and we used

Number 5 and his high-tech brethren — equally adept at decimating tanks and mixing martinis — snap to attention before an audience of military and congressional bigwigs on hand to observe a demonstration of their advanced capabilities. The synchronized salute was achieved rather simply by having all five robots' arms controlled by a single radio transmitter. / For Badham and others on the production, Number 5 quickly became an integral member of the cast — and as such, was often spoken to and given direction on the set. / For Number 5, life begins in a shower of sparks as lightning strikes his power cart.

Inadvertently tossed off a high bridge, Number 5 quickly deploys a parachute and drifts safely to the ground. To accentuate the apparent magnitude of the drop, eight half-scale robots were constructed for the scene. / The founding Number 5 is taken in by Stephanie Speck (Ally Sheedy) who accommodatingly feeds him insatiable thirst for 'input' by exposing him to books and late-night television. / Startled by Stephanie's dog, Number 5 tumbles off her porch and into a chicken coop. Referring to a video monitor, puppeteer Rico Topazio practices robot arm movements while the film crew prepares for a two-camera setup. / Head 'roboteer' Tony Urbano discusses a scene with Ally Sheedy and John Badham prior to photography. / Outside her home in the film, Sheedy rehearses a scene with the puppet robot.

that one to solve the electronics difficulties. After we rebuilt it, it ended up being the best, most reliable robot we had for the duration of the show — he seemed to actually exceed his battery life."

Badham, his crew and actors were already on location in Oregon awaiting the arrival of their star. Though ninety-five percent completed, the Number 5 action props still required minor adjustments when they were loaded on the forty-eight-foot trailer that would take them to location and serve as Allard's portable shop. At the height of production, Allard had employed forty-seven crew members. That crew was now pared down to only fifteen who would accompany him to Oregon to help operate and maintain the robots.

Though extremely complex and cleverly constructed, the Number 5 action props were still just inert pieces of equipment. To bring those forms to life took not only the talents of Eric Allard and his crew but also the experience of a group of veteran puppeteers headed by Tony Urbano. "John Badham was interested in using us," Urbano said, "but we agreed that our hiring would depend on a little screen test he wanted us to do. He gave us six weeks to learn how to work the robot and get used to it, and then he wanted me to present a scene from the picture. I picked the scenes where Number 5 and Ally are out on the deck looking at the sunrise and also the scene with the grasshopper. I felt those two scenes had both humor *and* dramatic impact. I knew we could handle the funny part — that's what we do all the time — but I wanted to show that we could also carry the deeper moments of the film. So John came in and directed this little test film; and while that was going on, a slender, white-haired gentleman came in. He was grinning from ear to ear and he kept saying: 'They're great! That's wonderful!' Carl Johnson, one of my puppeteers, looked up at me and said, 'I don't know who that guy is, but I hope he's someone important.' It turned out to be Larry Turman, and the next day we got a call saying we had the job."

To meet the challenge of creating the main character of a film primarily through puppeteering, Urbano and his crew began rehearsing with the Number 5 puppets as early as possible. "Even before Eric had them completed," Badham related, "Tony and his guys would go over to the shop and rehearse with them all afternoon. There was a group of four 'robotees' — which is what I preferred to call them — that regularly operated Number 5, and together with Eric and his people those guys *were* Number 5. They brought him to life. It was quite a responsibility because Number 5 was the star of the movie. Ally Sheedy and Steve Guttenberg were the costars and I told them that when we first started. I told them if they didn't agree with me, just wait until we'd been shooting for a couple of weeks and see who got all the attention. They took that to heart and were really very good about it." In fact, within a few days, the entire cast and crew had become accustomed to the new 'actor' in their midst. "Ally Sheedy got into it right away," Allard recalled. "She'd come in and say, 'Good morning Number 5,' and those







of us who were operating him would play along and make him wave or something. Before long, everybody was interacting with this thing as if he were a real character. Even John would say, 'Okay, Number 5, move over here,' just as if he were any other actor. It took about four weeks to get into the flow of things, but eventually we got to a point where the group of us were like one actor, taking direction and moving accordingly."

Much to their surprise, Tony Urbano and his crew of roboters — Tim Blaney, Carl Johnson and Rico Topazio — had the opportunity to make their own creative contributions. "John gave us freedom to create personality and business and movements, all the way down the line. When he hired me, he said he wanted us to give this robot all the acting ability that was necessary to carry the movie. At the time I'd thought: 'Yeah, sure. I'm going to get in there and suggest something and he's going to say no.' But it turned out to be nothing like that. John was so supportive. Most directors we have worked with are not particularly patient with our kind of work — they're not technically oriented and they don't understand when things break down. But John was extremely patient and he encouraged us to take this thing to its limit. It wasn't standard puppeteering because we wanted the character to look *real*. If we'd done a lot of showy things, he wouldn't have seemed alive — he just would have seemed very cleverly operated. In other words, making him come to 'life' was a matter of not doing *too* much. We relied on basic animated cartoon theory — starting with a good beginning pose, finding a great ending for the movement and then in-betweening them. We'd decide what his reactions would be to certain things — would he be happy or sad or startled or pensive? And we always tried to build in a moment before he reacted, just a second of time for him to 'think' before he responded. It made him more human and fallible. We tried to get rid of any surplus movement and just leave him with those expressions that really *said* something and would help the audience relate to him."

Shots were divided between those that would require the more capable robot puppets and those that needed the remote control models. For both, however, actual operation was a cooperative effort between Eric Allard, Tony Urbano and their respective crews. "The Type 1 remote-controlled robot took at least four people to operate," explained Allard, "and on some of the more complicated shots as many as nine. I usually drove the base and operated the lower portion; Tim operated the head mechanisms; Tony did the facial expressions and Rico operated the arms. The arms were consistently a problem because the servos in them were just at the limit of their capability — it didn't take much to put them out. Another problem we had with the remote control robots was the fact that there was so much rain on that location. It rained the entire first two weeks we were there and I had told them before we even got there that rain would shut us down. After two weeks of it, *everything* was wet and we started having some electrical failure. They also started behaving erratically — one robot ran away on us one

time and I had to chase it down the street. We were trying to get a shot of the robot going inside the truck and we never did get one we were satisfied with. It just wouldn't behave — it ran away and did what it wanted to do. But considering those horrible wet conditions, they held up remarkably well." Electronic disruptions aside, John Badham was more than pleased with his star performer and appreciative of the less-than-ideal conditions in which Allard and company were working. "It was perfectly understandable," Badham conceded. "Try watching your TV out in the rain sometime and see how well it works. Eric did everything he could — he always had the robot covered with plastic sheeting and little raincoats — but that humidity eventually crept into everything. I began to appreciate why the shark in *Jaws* caused so much trouble."

While Eric Allard was responsible for maintaining the remote control robots, continuity of character and 'acting style' demanded that the same roboters that would be operating the robot puppets for closeup shots have some input in the operation of the long shot robots. "I was a little nervous about how the remote control robot would perform," Urbano confessed. "Would he cut in all right with the puppet stuff? Number 5 couldn't just be funny and clever and agile in closeups and then when the movie cut to a long shot have him be this stiff, mechanical figure. Because the arms on the remote control ones had limited movement, we had to be careful as to how much movement we could do with the arms of the puppet — again, the two types of robots had to cut together seamlessly in the film."

Working with radio control mechanisms was rather unusual for puppeteers accustomed to more direct, hands-on techniques. "Tim Blaney sat at a table about five to ten feet away from the character and operated the hydraulics of the neck and head from there," said Urbano. "The table had a T-bar built onto it and by tipping the T-bar, the head would gimbal. Swiveling the T-bar made the head turn left or right. Also, two switches were built into the T-bar that brought the neck forward or back and raised and lowered the body. So Tim was operating all of that and at the same time saying Number 5's lines. I operated the facial expressions from two radio control panels with eight to ten switches that manipulated his eyes, eyelids and antenna. Usually we had monitors in front of us so we could see what we were doing with the character. Of course in certain situations, like in the catering truck, we didn't have the luxury of monitors and we just had to wing it." Each puppeteer became a specialist of sorts in his manipulation of a particular part of Number 5, whether it was the remote-controlled version or the mounted, waist-up puppet. The head and voice were Tim Blaney's specialty; the facial features were always operated by Tony Urbano; and Eric Allard and Rico Topazio controlled the articulation of the cable-actuated arms. Shortly into production, the puppeteers became competent with both types of robots, and which type would be used was dictated by the demands of the sequence.

The opening scenes of the film called for an impressive demonstration before a skeptical crowd of military and government officials. The sequence required the services of five of the remote control robots as well as the use of insert arms. At Tony Urbano's suggestion, the 'villain' robots — as all the robots except Number 5 were dubbed — were operated solely by Eric Allard and his crew. "After spending two months learning to put personality into this thing," Urbano commented, "I was afraid some of that personality would show up in the bad guy robots no matter how hard we tried not to. By having Eric and his group manipulate the five robots at the beginning, we essentially had a different 'actor' behind the machine."

Though the opening sequence was scripted to be an amazing display of the robots' capabilities — from decimating tanks to mixing a martini — most of the tricks performed by the mechanical show-offs were relatively easy to achieve. "Some of the things we thought would be the most difficult ended up being the simplest," Allard confessed. "Having them salute exactly together turned out to be a matter of putting the same crystal in all of their arm functions — one radio control did all the saluting. And, by using the insert arms, mixing the martinis wasn't a problem at all. Rico and I worked the sequence out together since we were the two with the most experience manipulating the arms. The only problem with it was that the geometry of the hands didn't allow for a lot of leverage for picking things up. So we helped the hands out by putting double-faced tape on the fingers which gave us a better grip on the glasses. Actually, the most difficult part of the opening sequence turned out to be just getting the robots to run in tight formation down the corridor. It was shot in one big master shot so we had five operators crammed in corners, using video to see what was going on."

After Number 5's miraculous 'birth' via a freakish act of nature, he distractedly rolls himself aboard a truck which takes him outside the fences of the Nova facility and into the big wide world. Undeterred by a failed attempt to communicate with a gas pump, Number 5 sets out on a consciousness-raising odyssey that is promptly cut short when a close encounter with some freeway traffic sends him tumbling off a bridge. In true James Bond fashion, he deploys a parachute and lands safely on the roof of Stephanie Speck's catering truck. The sequence was shot in three separate phases. The first phase entailed throwing one of the seventy-pound, full-sized stunt robots off a bridge which spanned the Columbia River at the location site in Oregon. "We used a real Type 1 robot going up the ramp and then we sling-shot a stunt robot off the bridge," Allard explained. "We ended up throwing two of them off the bridge — they fell one hundred and eighty feet and just disintegrated at the bottom. In fact, after shooting this, we were down to only one stunt robot; so we made another four back at the shop in L.A. Fortunately, we already had all the templates, so it wasn't difficult to crank them out."

Allard had built eight half-scale robots, equipped with little

On the set representing Stephanie's living room, John Badham restages one of his classic Saturday Night Fever dance routines with Number 5 standing in for John Travolta. Both the radio-controlled robot and the cable-controlled half-robot were employed in the sequence, augmented where necessary with marionette-style wire work. / An air-bearing platform — akin to a hovercraft — was provided by Eric Allard. Floating frictionlessly above the floor, the platform supported both puppet and operators and allowed for smooth, flowing dance moves. Two weeks of independent rehearsal were required to choreograph and perfect the difficult routine, which was then shot on stage in only two days.

Number 5 strikes a proud pose after deftly disassembling the car belonging to Stephanie's obnoxious ex-boyfriend. During principal photography — to aid in the rotebooteering effort and provide interaction for the actors — puppeteer Tim Blaney read Number 5's lines, many of which were ad-libbed. Badham later decided to retain Blaney's distinctive voice, which was re-recorded to enhance audio quality and then turned over to sound effects impresario Frank Serafine for electronic processing. Employing FM-synthesis techniques, a high-tech metallic digitization sound was created and then — by means of a Y-Expressor — married with Blaney's voice, tracking the dialog precisely. The combined result was then phase-shifted to give it a more localized quality as if it were actually coming from the robot. As an added subtlety, Number 5's voice was pitch-shifted in the early reels to impart a suggestion of robotic youthfulness, while in later reels it was lowered as he grew more mature.

parachutes, specifically for the second phase of the sequence in which Number 5 deploys his parachute and floats serenely towards the ground. The miniature scale was not only the most practical way of achieving the shot, it was essential in creating the dramatic and visual effect that Badham was after. "We used the tallest bridge we could find in the area," Badham noted, "but it still wasn't tall enough to give us a nice long fall. So I reasoned that if we used a three-foot-tall robot instead of a six-foot-tall robot, it would fall twice as long. I also used slow-motion to give it a nice, floating feeling. It was great to watch — the parachutes dutifully opened every time and Mike Sorenson was able to steer them from the ground by remote control. I thought they'd wind up crashing at the bottom, but he was able to guide them so they landed in the river unharmed."

The final phase of the sequence was shot weeks later on a process stage in Los Angeles. It was just one of several major effects requiring the special talents of special effects supervisor Chuck Gaspar. "I'd had an idea for getting Number 5 to land on a truck that was actually moving, on location," Gaspar recalled. "I was going to put the catering truck on a forty-foot flatbed, erect scaffolding on each side with a track in between and then travel with the truck itself, dropping Number 5 on the catering truck while it was moving. But John decided it was too complicated and opted for doing it on a process stage instead. Number 5 was hung from an overhead carrier with a sliding door track on piano wire. The catering truck was stationary and we just landed him on it, which was fairly simple. The hard part was getting the parachute to collapse behind him. It kept getting tangled up in piano wire and we had to do about ten takes on it before we got it right." To get the full range of expression and gesture as he landed, one of the fully-articulated, remote control robots was used for the scene.

Stephanie is blissfully unaware that the mechanical creature has hitched a ride until later that night when sounds of enthusiastic exploration emanate from her truck. Upon investigation, she discovers what she thinks is an extraterrestrial and cautiously lures Number 5 into her home. Once inside, she feeds his insatiable appetite for 'input' by giving him every last bit of reading material she possesses. With a reading ability that would put Evelyn Wood to shame, Number 5 absorbs the texts in amazingly short order. "That was one of the few times that we actually went for a gag rather than realistic movements," Urbano commented. "I just moved his eyes back and forth as fast as possible while an air hose flipped the pages and Rico did super-quick hand movements." Exhausted, Stephanie finally goes to bed, leaving her tireless visitor to continue his questionable education via late-night television.

The rather sweet relationship between Stephanie and Number 5 that is first evidenced on the deck outside her home the next morning was actually a step back from what John Badham had intended. "I included a lot of little scenes and bits of business that established Number 5's attachment to Stephanie," Badham related, "things like her resting her head on his shoulder and

hugs and kisses. But when we showed the film in early previews, audiences got real irritated with that — they booed and hollered and hissed, so I wound up taking most of it out. The more romantic and mushy among us were ready to go all the way with it, but the audience was obviously not happy seeing Ally Sheedy kiss and hug a robot."

The moment is interrupted when Stephanie's mongrel dog barks at the strange intruder who, in startled reaction, tumbles off the edge of the deck and into a chicken coop below. "We wanted to have his arms flailing backwards as he was going over the edge," Allard said, "and it was one of the few times we had to resort to marionette techniques. Since the arms were always the most limited part of all the robots, there was no way we could have gotten that much movement out of them by remote control. We loosened up all the arm axes and disconnected some of the metal on one of the puppets, put strings on either end and just rotated the arms backwards. Then we cut to one of the stunt robots for the actual fall into the chicken coop. The marionette approach worked real well and we used it in a couple of other instances — in the scene where Number 5 deflects the bullets that Stephanie's boyfriend is shooting at him, for example, and again during the *Saturday Night Fever* dance when he imitates some of John Travolta's movements."

Having survived his fall into the chicken coop, Number 5 goes on to explore his surroundings, chasing a grasshopper and joyfully imitating its hop across Stephanie's front lawn. Though the scripted sequence would be an obvious crowd-pleaser, the filmmakers looked forward to the grasshopper chase with particular dread. "We made a big fuss about it," Badham recalled. "We were just certain that it was going to be a *terrible* ordeal to get that robot to hop. But as it turned out, it was relatively easy. Chuck Gaspar came up with this outrageous rig and we shot the sequence in the course of just one morning."

"For the jumping scenes," Gaspar explained, "Number 5 was suspended on piano wire from an overhead rail that enabled him to move across the area where he was chasing the grasshopper. He was also attached to a cable that we could raise and lower — aided by counterweights — at the same time he was traveling, which gave him the hopping movement. We used one of the stunt robots that had track movement so that every time he came down from a hop, his tracks were still moving. The tracks were designed to tilt up and down so that when we lifted him up, he sort of looked like he was on his tiptoes. It was one of those things that impresses an audience, but wasn't really difficult to do and only took a few hours to shoot. In contrast, later in the film when Number 5 slices the boyfriend's rifle up like a loaf of bread, that was *very* difficult and probably amounted to a whole month's work for one man. Yet it goes by in a few seconds and no one thinks anything of it."

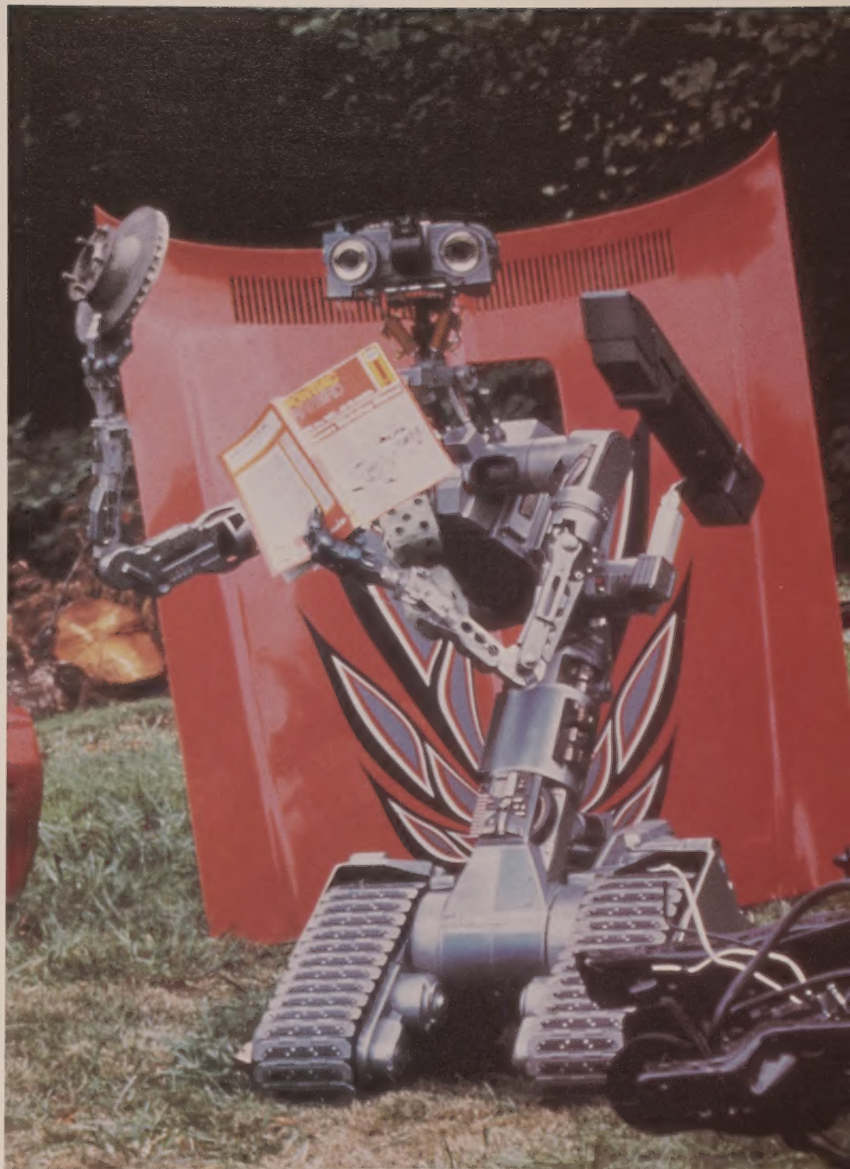
Number 5's encounter with the crushed grasshopper brings with it the awful realization that his precious and new-found life is tenuous and that there is no 'reassembling' for vulnerable living beings. Knowing that Nova brass are on their way to take

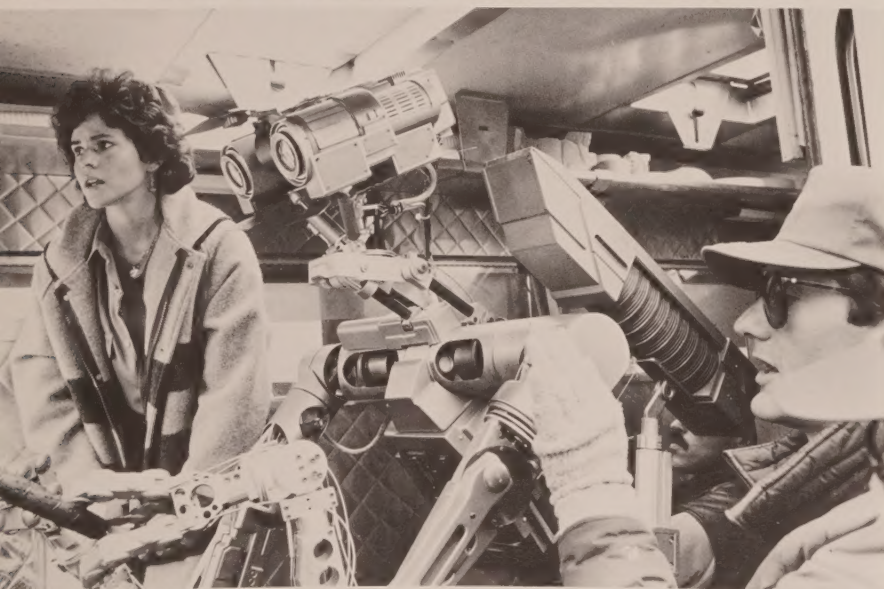
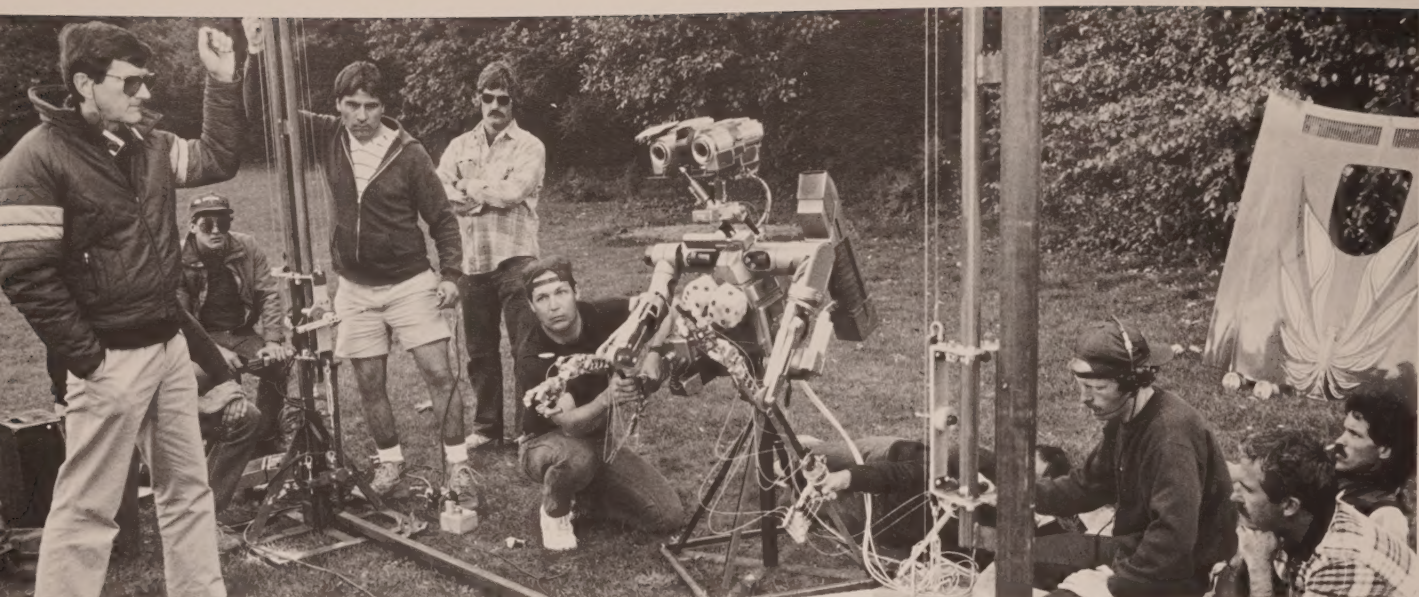
him back to the facility to be disassembled, Number 5 makes a bold escape employing Stephanie's catering truck as his getaway vehicle. "Just getting him into and out of the truck was very involved," noted Gaspar. "To help him enter, we built a platform with a treadmill on it — just like Number 5's tracks. It was buried in the ground and it had a telescoping ram — a hydraulic cylinder — that would raise up as the robot's tracks met the tracks of the platform. By positioning his arms at the top of the doorway, it would look like he was lifting himself up into the truck." Just getting the sometimes errant remote-control robot to hit the proper position on the platform was oftentimes a hit-and-miss affair — with the emphasis on the 'miss.' Luckily, getting Number 5 to exit the vehicle was a little easier. "All we did was make a cable ramp with piano wire and have the robot itself drive down it. A safety line was attached to his back and we slowly let him out under his own power."

As capable as Number 5 was, he still needed considerable assistance in actually driving the truck. Called a 'blind drive,' the technique is commonplace in Chuck Gaspar's line of work. "It's the type of effect we do all the time. We take a boat-steering system and drive from another place within the vehicle. It's done hydraulically and you can be hidden anywhere in the vehicle, off-camera. The driver is usually a stuntman and he has vision outside the vehicle. The only problem with it was that it could get very crowded in there — stuntmen, technicians and puppeteers all in a pretty confined space."

Now a hotly pursued fugitive, Number 5 returns to Stephanie's home for sanctuary. The soft-hearted caterer cannot bring herself to turn him away and the two of them pass the evening dancing. Though the script referred to the dancing in a general way, John Badham knew *precisely* what dance they would perform. "It would have been ridiculous for me to use a dance from *Flashdance* or *Grease* or from an old Fred Astaire movie. I had filmed one of the classic dances of film history in *Saturday Night Fever* and that's what it had to be." To prepare for the sequence, Number 5 and his roboteers attended dance class for two weeks. "We looked at what Travolta did and decided what specifically we wanted Number 5 to mimic. In a way, Number 5 reminded me of Travolta during the rehearsal period. John had had to work like hell to do what he did and he had been scared to death about it. Number 5 worked like hell too, rehearsing with Ally for a long time. Eventually, they got really good at it."

For Eric Allard and Tony Urbano, the dance sequence provided an opportunity to strut their robotic stuff. "I really wanted to go wild with it," Urbano stated. "There were really only two places in the movie where we could get flamboyant with the puppeteering — the Three Stooges routine and the dance. So we exploited the opportunity to the limit. We tried to incorporate not only the bits of the dance that would be funniest when Number 5 imitated them, but also those parts that would show the widest variety of movement. Eric Allard had a real facility for moving him around the floor and a lot of old marionette





techniques came in handy. John gave us a whole week to shoot the sequence — this was on a stage in L.A. after we'd returned from location — but it ended up taking only two days. It would have taken even a shorter amount of time except that we had to use very heavy piano wire on him for some of the arm movements and they showed up the first time. So we had to go in and reshoot it with different lighting."

Eric Allard provided the robotics crew with an air-bearing platform on which to mount the puppet. Working on the same principle as a hovercraft, the pneumatically-operated platform floated two or three thousandths of an inch off the floor and allowed for amazingly smooth, almost frictionless movement. "We had four operators on the platform with Number 5," explained Allard. "Rico Topazio was at the elbow manipulating the arm movements and Tim Blaney would operate the T-handle joystick that articulated the head. Then we needed another two operators to guide the platform itself." For shots of Number 5 dancing alone, the fully-articulated, Type 1 robot was used, aided considerably by wires attached to his arms.

Enjoying the apparent safety of his new home, Number 5 arises the next morning, dons an apron and proceeds to prepare a totally unappetizing breakfast for Stephanie. It was one of only two sequences in which the tool arm that had figured so prominently in the script was actually employed. It had been seen, briefly, earlier in the film when Number 5 uses it to start the ignition of the truck. Now it came in handy as a means of turning a manual egg beater into an electric one. Built by Mark Noel, the tool arm was electronically and pneumatically controlled. Though a remarkable piece of gadgetry, it required the hands-on manipulation of an operator and was therefore used primarily with the puppet. The breakfast-making sequence was one of the more difficult to shoot. "Anything with digital dexterity like that was *very* time consuming," stated Badham. "It took us a long time to get Number 5 to make that breakfast and it was a real mess — pancake batter was splattered everywhere. It was hard enough to get Number 5 to do those things in the first place — like cracking an egg or picking up a measuring cup — but to have him do it *and* look *good* doing it was even harder."

The laboriously prepared breakfast would never be consumed. His hideout discovered, Number 5 spends the rest of the movie running for his freakish life with an entire army of Nova security personnel in hot pursuit. Now a seasoned four-day-old, Number 5 no longer relies on Stephanie for protection and, in fact, becomes the aggressor in outsmarting his enemies. Quickly disassembling the car belonging to Stephanie's ex-boyfriend, he taunts the obnoxious suitor by smugly tossing a coinlike fender washer in the air — a trick he picked up on TV from George Raft. The coin-flip would prove to be the most complicated gag of the film for the physical effects crew. "We suspended the 'coin' between two piano wires," Gaspar explained. "First we grooved the washer and then put the piano wire in the groove and just soldered back over it and blended the wires

out by painting them. The piano wire extended out to a square framework about ten feet across. The framework had motorized travelers that would cause the coin to raise and lower *plus* bearings that rotated the coin as it went up and down. So the robot would flip the coin with his 'thumb' and we'd take it up on the travelers — rotating the whole time — then bring it down, stop the motors and do the whole thing again. It was shot undercranked because to be able to get that coin to come down and land exactly in his hand would have been very difficult at normal speed."

Finally deciding to fight fire with fire, Nova sends out four 'villain' robots to subdue the errant runaway. Number 5 outsmarts them, however, and — again inspired by his late-night television viewing — rewires their circuitry, turning the lethal, high-tech soldiers into helpless Three Stooges-type buffoons. The time-consuming sequence — the only one in the film requiring complicated manipulations of several robots at the same time — was relegated to second unit. Since the puppet robots were the only ones maneuverable enough to mimic a typical Three Stooges routine, the choreography of the sequence fell to Tony Urbano and his crew. "It was difficult enough to get a *single* robot to do what we wanted," noted Urbano. "To do three at once and coordinate all of those movements was *really* difficult. I had wanted to do that scene in true Three Stooges style — the routines John had given us to study on videotape had a limited number of camera moves and that seemed to be the best way to go for us as well. The camera would just lock in on all three of them and they'd do their thing. So I worked out how it could be done and because I was scheduled to have an entire day to shoot it, I was confident that it could be really spectacular. Unfortunately, we wound up with only *four hours* in which to do it — and the second unit insisted on shooting it before we really even had time to rehearse. There were twelve of us operating the puppets — four puppeteers and eight technicians — and we did the best we could. In the end, I guess there's nothing to complain about because the sequence always gets a big laugh, but it was John's editing that made it work."

In the final accounting, *Short Circuit's* mechanical star came in at \$1.4 million — from the first day of building to the last day of filming. "It was a bargain," Badham assessed, "considering what the star of a movie can cost these days. Eddie Murphy would have cost us *twice* as much. And, unlike Eddie Murphy, we can use him again." For Eric Allard, it was John Badham's mastery of his mechanical star, as much as the effectiveness of Number 5 himself, that brought the film in on budget and with such great success. "John took everything he had available to him at the moment he needed to get a shot and *used* it. Number 5 had thirty-two articulated functions and it was inevitable that every now and then one of them might not be perfect. But John's attitude was that whenever that happened he still had thirty-one other functions at his disposal and he took advantage of what he had to work with. He had a flexible tool and he learned how to use it."

Number 5's fender washer 'coin-flip' trick presented physical effects coordinator Chuck Gaspar with his most difficult assignment on the film. Attached invisibly between two wires, the washer was suspended from a large steel framework equipped with motorized travelers to make it raise and lower on cue, plus bearings that caused it to rotate at the same time. Eric Allard controlled the robot's coin-flipping arm, while Tony Urbano and his crew provided the robot's other articulations. / Ally Sheedy, Number 5 and John Badham prepare for a scene inside Stephanie's catering truck. / Crowded into the rear of the vehicle, Urbano and company provide articulation for the puppet robot hunched over the wheel.

